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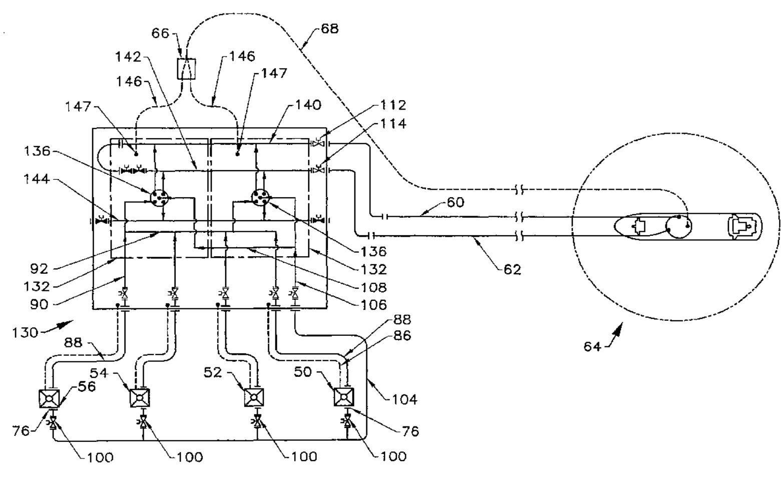
(54) Title: WELLHEAD PRODUCT TESTING SYSTEM



(57) Abstract: A method of controlling flows from plural hydrocarbon extraction wellhead trees (50, 52, 54, 56) in an extraction system including plural wellhead trees (50) connected by a pipeline network (60, 62, 88, 104) to a host facility (64) via a manifold system (130, 132) situated remotely from the host facility (64). Each wellhead tree (50) has a production outlet connected by a production conduit (88) to the manifold system (130, 132) and a test flow outlet (76) connected by a test conduit (104) to the manifold system (130, 132). Wellhead tree outlet valves are operable to divert the flow from one wellhead tree only to the manifold system (130, 132) from where it is routed via a test pipeline (62) to testing equipment at the host facility. Alternatively, one or more modules (132) of the manifold system (130, 132) may be replaced by one or more different modules each containing a multi-phase flow meter so that testing can take place at the manifold system. The method obviates the requirement for remotely operable valves to be installed in the manifold system for flow testing purposes.

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WELLHEAD PRODUCT TESTING SYSTEM

The present invention relates to a method and apparatus for diverting the fluid flow from a wellhead tree or trees in a hydrocarbon extraction system to a testing means for analysing its content.

The invention is described in the context of a system for extracting hydrocarbons, such as oil and gas, from a sub-sea location, but is equally applicable to extraction from other locations, particularly those in which access creates a problem for example in swampy areas. References to wellhead trees can alternatively be taken as references to wellheads per se.

A typical prior art system is shown in Figure 1. Such a system generally includes plural wellhead trees 2, 4, 6 and 8 on the seabed through which a combination of oil, gas and water flow from a deposit below the seabed. The trees are generally connected to a manifold system 10 including valves which are operable to selectively divert flows from the trees into a production pipeline 12 leading to a host facility 14 which may be tens of kilometres away and a test pipeline 16 also leading to the host facility. The valves in the manifold system generally include a main valve 18 for each tree, which is typically diver or remote vehicle operable and not regularly opened and closed during normal operation of the system, and a pair of diverter valves including a production valve 20 (opened when flow from the associated tree is to enter the production pipeline) and a test valve 22 (which is opened instead of the production valve 20 when flow is to enter the test pipeline). It is necessary to regularly analyse

the flow from each tree in turn to ascertain that optimum extraction is occurring. When, for example output from tree 2 is to be tested, its associated production valve 20 is closed and test valve 22 is opened. While flow from the trees 4, 6 and 8 continues to flow into the production pipeline, that from tree 2 flows into the test pipeline. Once any residual material in the test pipeline has been cleared, the output of tree 2 can be collected at the host facility for analysis. Once the valves are returned to the states shown in Figure 1, the operation can be repeated for the other trees. To avoid the requirement for a diver or remotely operated vehicle to effect actuation of the production and test valves, they are generally remotely actuable and controlled by means of signals sent to the manifold system from the host facility by an integrated service umbilical 24 which enters the manifold system at an umbilical termination assembly 26 from where the signals and power are directed to a sub-sea control module 28 and on to the trees and diverter valves (signal and power connections 30, shown by dotted lines are only shown for tree 8, the other connections having been omitted for clarity). The incorporation of remotely actuable valves 20 and 22 and their associated actuators 32 and 34 in the manifold system, which is a relatively permanent fixture on the seabed, constitutes a problem because they may require periodic maintenance in order to function efficiently and may even need replacing from time to time. Accordingly one object of the invention is to eliminate such remotely actuable diverter valves and their associated actuators from the manifold system.

When a sub-sea control module 28 is installed in the manifold system, it involves the mating of hydraulic,

electrical and possibly chemical injection lines. The making and breaking of such connections in deep water poses potential problems and accordingly it is a further preferred object of the invention to eliminate, when possible, the requirement for such a control module in the manifold system.

The inventors have recognised that, because the wellhead trees by necessity include remotely actuable valves with associated actuators (usually hydraulic) and a sub-sea control module for effecting actuation of the valves, the overall reliability of the trees is not significantly reduced by the incorporation of additional remotely actuable valves and associated actuators.

An alternative prior system for analysing flow from a particular tree is shown in Figure 2 in which parts corresponding to those shown in Figure 1 are designated with the same numerals. In this system, each test valve 22 is connected to a multi-phase flow meter 40 rather than to a test pipeline 16. This arrangement avoids the problem of having to flush fluid from a possibly very long pipeline between the testing of the flow from each tree and the problem associated with phase separation and other changes which tend to occur as the test flow travels along the pipeline. Such multiphase flow meters are however very expensive, prone to malfunction and are not particularly accurate.

According to the invention there is provided a method of controlling flows from plural hydrocarbon extraction wellhead trees in an extraction system including plural wellhead trees connected by a pipeline network to a host

facility via a manifold system situated remotely from the host facility, the method involving selective opening and closing of valves controlling the flows through the pipeline network to enable selective delivery of output from a selected wellhead tree to testing means for analysing the content of the output from the selected wellhead tree wherein the method includes the steps of providing each wellhead tree with a production flow outlet, a test flow outlet and valve means operable to selectively divert the output from the wellhead tree through one of the outlets and operating the valve means to divert the output of one wellhead tree only to the testing means.

Such a method obviates the requirement for remotely actuable valves and associated actuators in the manifold assembly which will increase its reliability considerably. Provided no such valves and actuators are included therein for other purposes, the chance of needing to maintain equipment of the manifold system can be substantially eliminated.

Furthermore, if the manifold assembly simply routes flows into the production and test pipelines, the need for a sub-sea control module in the part of the manifold assembly permanently connected to the seabed can be avoided. This is also the case when the manifold assembly comprises a docking manifold in which insert retrievable system modules are located, since such system modules can each contain their own system power and control modules.

If power and control are supplied directly from the host facility to the trees, it may be possible, depending on

other system requirements, to avoid providing any power and control to the manifold system.

Preferably the method involves the step of providing each wellhead tree with a production flow valve and a test flow valve for respectively controlling output through the production and test flow outlets which valves constitute the valves means of the wellhead tree.

In order to minimise the amount of sub-sea pipelines, preferably the method includes the step of connecting the test flow outlets of two or more wellhead trees with each other by a test conduit to form a wellhead tree group and connecting the test conduit to the manifold system. More preferably two or more wellhead trees of the group are connected in parallel to the test conduit.

Conveniently the method includes the step of opening the test flow valve of a selected one of the wellhead trees of the group only while maintaining the others closed and passing output from the selected wellhead tree to the testing means via the test conduit.

The output from the selected wellhead tree may pass through a portion of the test conduit connecting two wellhead trees prior to passing through a different part of the test conduit for delivery to the manifold system.

So as to reduce the interdependency of the system components and permit one of the wellhead trees to be completely closed down and possibly recovered to the surface for maintenance or replacement, preferably the method includes the step of connecting the test flow

outlet of each wellhead tree to the manifold system by an individual test conduit.

With such an arrangement, preferably the method involves the step of opening the test flow valve of a selected one of the wellhead trees only while maintaining the others closed and passing output from the selected wellhead tree to the testing means via the corresponding individual test conduit.

Preferably the manifold system comprises a docking manifold for receiving one or more system modules for acting on wellhead tree outputs flowing through the manifold system and the method includes docking at least one such system module in the docking manifold. The use of such system modules permits different production phases of an oil field to be catered for by substituting appropriately configured system modules as explained more fully below.

At least one system module docked in the docking manifold may simply provide throughflow connection firstly between the production flow outlets of the wellhead trees and a production pipeline connecting the docking manifold and the host facility and secondly between the test flow outlets of the wellhead trees and a test pipeline connecting the docking manifold and the testing means which is situated at the host facility, the method including the step of conveying output from a selected one the wellhead trees to the testing means via the system module. Such a method is appropriate in the early production phase of the oil field when oil with relatively little water and/or gas issues from the wellhead trees

under high pressure.

In the latter phases of production, when flow from the wellhead trees is at a lower pressure and contains water and gas, preferably at least one system module docked in the docking manifold includes the testing means and separating means for separating constituent components of the flows from the wellhead trees, the method including the step of operating the valve means of the wellhead trees to divert the output from one selected wellhead tree test flow outlet only to the separating means and measuring and/or analysing its content with the testing means. The separating means may also constitute the testing means.

If there is a requirement to avoid the conveyance of test flows to the host facility, preferably at least one system module docked in the docking manifold firstly provides simple through-flow connection between the production flow outlets and a production pipeline connecting the docking manifold and the host facility and secondly includes the testing means, the method including the step of conveying output from a selected one of the wellhead trees to the testing means of the system module and analysing its content.

Preferably control signals are routed to the wellhead trees via the manifold system but without passing through any control means forming part of the manifold system.

The invention also provides a method of operating a hydrocarbon extraction system including the above method and including the step of conveying mainstream production

fluid (such as gas) from the separating means through the test pipeline used during an earlier phase of production to convey wellhead output to the test facility for testing.

The invention also provides apparatus for controlling flows from plural hydrocarbon extraction wellhead trees in an extraction system including plural wellhead trees connected by a pipeline network to a host facility via a manifold system situated remotely from a host facility characterised by each wellhead tree having a production flow outlet, a test flow outlet and valve means operable to selectively divert output from the wellhead tree through one of the outlets and an interconnecting pipeline network for delivering the output from one of the test flow outlets to the testing means.

According to a further aspect of the invention there is provided a wellhead tree including a production flow outlet and a test flow outlet and valve means operable to selectively divert output from the wellhead tree.

The invention will now be described by way of example only with reference to the accompanying schematic Figures in which:

Figure 1 shows a typical prior art system for diverting wellhead tree output flows to a host facility for testing

Figure 2 shows a prior art system for diverting wellhead tree output flows to a testing device associated with a sub-sea manifold system

Figure 3 shows a system according to the invention for

diverting wellhead tree output flows to a host facility for testing

Figure 4 shows a detail of flow diverting valves situated at each wellhead tree according to the invention

Figure 5 shows a second system according to the invention with a docking manifold in which two retrievable system modules are installable

Figure 6 shows the type of system module for use in the system shown in Figure 5

Figure 7 shows a variant of the system shown in Figure 5 for use with alternative system modules

Figure 8 shows the type of system module for use in the system shown in Figure 7

Figure 9 shows a further variant of the system shown in Figure 5 for use with a further alternative system module

Figure 10 shows the type of system module for use in the system shown in Figure 9

Figure 11 shows a further variant of the system shown in Figure 5 including alternative connections to the wellhead trees; and

Figure 12 shows details of flow diverting valves situated at each wellhead tree of the system shown in Figure 11.

The systems shown in Figures 3 to 12 are suitable for putting the various methods according to the invention into practice.

A first system for putting the inventive method into practice is shown in Figures 3 and 4. The system includes four wellhead trees 50, 52, 54 and 56 mounted on the seabed and connected by pipes to a seabed manifold system

58 which is connected by a production pipeline 60 and a test pipeline 62 to a host facility 64 (shown in Figure 3 as a floating production unit). The test pipeline 62 may be used in later production phases for the conveyance of a production fluid such as gas. An integrated service umbilical 68 containing electrical, hydraulic and also possibly chemical injection line(s) leads from the host facility 64 to an umbilical termination assembly 66 which may conveniently be mounted on the manifold system 58 to provide a secure anchoring location but may be situated elsewhere.

The wellhead tree 50 is shown in greater detail in Figure 4. Fluid flowing out of the tree is divertable at a junction 70 towards a production flow outlet 72 through a production flow valve 74 or towards a test flow outlet 76 through a test flow valve 78. These two valves are respectively controlled by actuators 80 and 82 which are controlled by a sub-sea control module 84 connected by a power and signal carrying control line 86 to the umbilical termination assembly 66. The production flow outlet 72 is connected by a production conduit 88 to a production feeder pipe 90 in the manifold system which leads into an inlet production header pipe 92. The production feeder pipe 90 has a main valve 96 which is operable by a diver or remotely operated vehicle. The inlet production header pipe 92 is linked by a further valve 112 to the production pipeline 60.

The test flow outlet 76 of the tree 50 is connected by a branch pipe 110 to a junction 98 in a test conduit 104 (which interconnects the wellhead trees) via an isolation valve 100 which is diver or remotely operated vehicle

actuable.

The above arrangement applies equally to the other three wellheads trees 52, 54 and 56.

The test flow outlet 76 of tree 50 is connected via the test conduit 104 to a test feeder pipe 106 in the manifold system 58 which leads into an inlet test header pipe 108 which is in turn connected by a valve 114 to the test pipeline 62. The test feeder pipe 106 contains a main valve 97 similar to main valve 96.

The test flow outlets 76 of trees 52, 54 and 56 are respectively connected by branch pipes 110 to interconnecting sections of the test conduit 104. Serially adjacent trees are accordingly interconnected in series. While four trees are depicted in Figure 3, other numbers of trees could be connected in a like manner.

Operation of the system shown in Figure 3 will now be described.

Throughout the operations described below, the main valves 96, 97 and valves 112 and 114 will remain open at all times.

During normal production, the test flow valves 78 of the trees are closed and the production flow valves 74 will be open. Production fluid will accordingly flow through the production conduits 88 and production feeder pipes 90 into the inlet production header pipe 92 from where it is routed via the production pipeline 60 to the host facility 64.

On a regular basis, it is necessary to test the flow from each tree individually in order to analyse its content, pressure etc. An appropriate signal is accordingly transmitted from the host facility 64 to the control module 84 of the tree concerned via the umbilical 68 and appropriate control line 86 which results in the actuator 80 closing the production valve 74 and actuator 82 opening the test flow valve 78 (as shown in Figure 4). Fluid flowing out of that particular tree will accordingly be diverted so as to flow out of its test flow outlet 76.

The test flow will travel directly into the test conduit 104, through the test feeder pipe 106 and into the inlet test header pipe 108 from where it is routed to the host facility 64 via the test pipeline 62. If the tree concerned is one of the trees 52, 54 or 56, the test flow from the tree will pass through one or more of the interconnecting portions of the test conduit 104 before entering the main part of the test conduit 104.

Before testing at the host facility 64 can occur it is first necessary to permit the test flow from the tree being tested to flush other fluid from the test pipeline 62.

Once testing has been completed, the test flow valve 78 and production flow valve 74 are closed and opened respectively to return to the normal production mode and testing of the flow from another well can commence.

The loop of pipe 116 interconnecting the production and test header pipes 92 and 108 is a so-called "pigging loop"

and used for clearing the pipes in a manner which is well known in the art and not of direct relevance to the present invention. The valves 118 are used when pigging occurs.

A second system which can be used to perform the method according to the invention will now be described with reference to Figures 5 and 6. Components of the system which correspond to those of the system shown in Figures 3 and 4 are designated with the same numerals and will not be described in detail below.

The manifold system of Figure 3 is replaced by a docking manifold 130 containing the pipes shown and adapted to receive two system modules 132. It may be designed to accommodate more than two such modules. Different modules, such as those shown in Figures 8 and 10 may be employed instead depending on what functions the modules are to perform.

As shown in Figure 6, a lower end of each system module 132 includes a first part 134 of a multi-pipe connector 138 which is engageable with complementary second part 136 of the multi-pipe connector 138. Pipes in the second part 136 are connected to the inlet production header 92 and the inlet test header 108 for routing fluid(s) from the trees 50, 52, 54 and 56 into the system module 132 and to an outlet production header 140, an outlet test header 142 and an outlet water header 144 for routing fluid(s) away from the system module 132.

The umbilical termination assembly 66 is shown separated from the docking manifold 130 but could be mounted thereon

and divides the integrated service umbilical 68 into two module umbilicals 146 each of which terminates in a wet mateable connection 147 for connection to a system power and control module 148 of the system module when it engages the docking manifold (connection not shown in Figure 6).

The system module shown in Figure 6 is for use during an early production phase of the oil field, at which stage oil flows from the trees at a sufficiently high pressure that gas does not tend to break out of solution and form gas slugs in the production pipeline. The system modules accordingly include a production loop 150 which connects the inlet production header 92 to the outlet production header 140 and a test loop 152 which connects the inlet test header 108 to the outlet test header 142. The outlet water header 144 is not used with this particular system module 132.

Control lines, which route signals from the wet mateable connection 147 to the trees, are only partially shown for reasons of clarity.

The trees and the interconnections therebetween and between the trees and the docking manifold 130 will be as described with reference to Figures 3 and 4. The method of routing the flow from one particular tree to the host facility will only differ in that production flow will pass into one of the two system modules 132 and pass around one of the production loops 150 and any test flow entering the docking manifold 130 via the test conduit 104 will pass into one of the system modules and around one of the test loops 152.

A third system which can be used to perform the method according to the invention is shown in Figures 7 and 8. Components of the system which correspond to those shown in Figures 3 to 6 are designated with the same numerals and will not be described in detail below.

The system shown in Figures 7 and 8 differs from that shown in Figures 5 and 6 in that it does not include a test pipeline 62 and it includes a different system module 158 having a single loop 160 containing a multi-phase flow meter 162 for analysing the content of fluid(s) passing therethrough.

The pigging valves 118 in the docking manifold 130 are open and the valve 114 is closed so that all fluid flowing out of the system modules 158 is routed through the production pipeline 60.

In the system module 158, flow through a first feed pipe 164 connected to the inlet production header 92 is controlled by a first feed valve 166 and flow through a second feed pipe 168 connected to the inlet test header 108 is controlled by a second feed valve 170. The configuration shown in Figure 8 corresponds to normal production (i.e. testing not taking place). By closing the first feed valve 166 and opening the second feed valve 170 with their associated actuators, under control of the system power and control module 148, a test flow diverted from a particular tree into the test header 108, in the manner described above, can be routed through the meter 162 and analysed. Test flows from the different trees can be diverted through the meter 162 for this purpose before

valves 166 and 170 are opened and closed respectively so that normal production can be resumed.

Information from the meter 162 can be processed locally by the control module 148 and used to control the trees or relayed to the host facility 64 for processing.

A fourth system which can be used to perform the method according to the invention is shown in Figures 9 and 10. Components of the system which correspond to those shown in Figures 3 to 8 are designated with the same numerals and are not described in detail below.

The system shown in Figures 9 and 10 differs from that shown in Figures 5 and 6 in that it includes two system modules 180 for separating flows received from the trees via the inlet production header 92 into its oil, gas and water constituent parts and delivers these separately to separate ports 182, 184 and 186 of the first part 134 of the multi-pipe connector 138. The multi-pipe connector connects: (i) the oil port 182 to the outlet production header 140 (as in Figure 5); (ii) the gas port 184 to an outlet gas header 188; and the water port 186 to outlet water header 144. Since separation and analysis of the flows can occur within the system module 180, there is no need to route tree flows back to the host facility 64 for analysis. Accordingly, the outlet test header 142 and test pipeline 62 are respectively redesignated as an outlet gas manifold 188 and a gas pipeline 190 for delivering gas from the system module 180 to the host facility. This double use of the pipeline 62/190 obviates the need to provide three separate pipelines (for oil, gas and test flows) from the docking manifold 130 to the host

facility 64. The outlet water header 144 is connected to a water disposal well 192.

A separator chamber 194 in the system module 180 is supplied with flows from the trees either via a first feed pipe 164 connected to the inlet production header 92 or via a second feed pipe 168 connected to the inlet test header 108. First and second feed valves 166 and 170 in these pipes respectively are operable as described with reference to Figure 8 to divert production flow from all of the wells into the separator chamber or merely divert a test flow from one of the trees thereinto, also as described above.

The manner in which components of the system module 180 act on fluids flowing therethrough will not be described in detail since it is not strictly relevant to the present invention. The components included in the system module 180 are labelled as follows: fluid interface level sensor 196; pressure sensor 198; modulating valves 200; flow meters 202; pumps 204; failsafe valve 206; and non-return valves 208. The system power and control module 148 receives signals from and controls the operation of most these components and others in the system modules 180. Between using the system modules 132 and 180 shown in Figures 6 and 10 respectively, an intermediate system module (not shown) may be used which includes a two-phase separator for separating the flows into oil and gas or water components only.

A fifth system which can be used to perform a method according to the invention is shown in Figures 11 and 12. Components of the system which correspond to those shown

in Figures 3 to 10 are designated with like numerals and not described in detail below.

The system modules 132 shown in Figure 11 correspond to that shown in Figure 6. As subsequent production phases of the oil field are entered, different system modules can be substituted for the system modules 132 as described above.

The main difference between the system shown in Figure 11 and that shown in Figure 5 is that the test flow outlet 76 of each tree 212 is connected by an individual test conduit 210 to the inlet test header 108. Furthermore, no interconnecting pipes are provided to link the test flow outlets 76 of the trees 212 and the trees 212 do not include isolation valves 100 or branch pipes 110. Accordingly, when there is a requirement to test the flow from one particular tree, a signal is sent to the appropriate actuators 80 and 82 of that tree so that the production flow valve 74 is closed and the test flow valve 78 is opened (as shown in Figure 12) whereupon flow from that tree passes directly to the inlet test header 108 in the docking manifold 130 via the corresponding test conduit 210 without being conducted via any other trees regardless of which tree is being tested. This arrangement results in it being possible to remove one tree from the system without affecting the operation of other trees in the same group.

In the accompanying drawings, valves shaded in designate closed valves and those not shaded in designate open valves.

While valve means forming part of the wellhead trees has been described, the production and test flow valves 74 and 78 may be closely associated with the associated tree rather than forming part thereof.

The integrated service umbilical 68 described may be replaced by one or more leading directly from the host facility to the wellhead trees.

Each header pipe referred to above could be described as an individual sub manifold within the associated manifold system or docking manifold.

It will be appreciated that system components and method steps referred to may be used in combinations other that those described with reference to exemplary embodiments referred to above and shown in the accompanying Figures.

CLAIMS:

1. A method of controlling flows from plural hydrocarbon extraction wellhead trees (50, 52, 54, 56) in an extraction system including plural wellhead trees (50 ...) connected by a pipeline network (60, 62, 88, 104) to a host facility (64) via a manifold system (58) situated remotely from the host facility (64), the method involving selective opening and closing of valves (74, 78) controlling the flows through the pipeline network to enable selective delivery of output from a selected wellhead tree (50...) to testing means for analysing the content of the output from the selected wellhead tree wherein the method includes the steps of providing each wellhead tree (50...) with a production flow outlet (72), a test flow outlet (76) and valve means (74, 78) operable to selectively divert the output from the wellhead tree (50...) through one of the outlets (72, 76) and operating the valve means (74, 78) to divert the output of one wellhead tree only to the testing means.

2. The method of according to claim 1 including the step of providing each wellhead tree (50 ...) with a production flow valve (74) and a test flow valve (78) for respectively controlling output through the production and test flow outlets (72, 76) which valves (74, 78) constitute the valve means of the wellhead tree (50...).

3. The method according to claim 1 or 2 including the step of connecting the test flow outlets (76) of two or more wellhead trees (50 ...) with each other by a test conduit (104) to form a wellhead tree group and connecting the test conduit (104) to the manifold system (58).

4. The method of claim 3 wherein two or more wellhead trees (50...) of the group are connected in parallel to the test conduit (104).

5. The method of claims 2 and 3 including the step of opening the test flow valve (78) of a selected one of the wellhead trees (50 ...) of the group only while maintaining the or each other test flow valve (78) closed and passing output from the selected wellhead tree (50...) to the testing means via the test conduit (104).

6. The method of claim 5 wherein output from the selected wellhead tree (52, 54, 56) passes through a portion of the test conduit (104) connecting two wellhead trees (50, 52, 54, 56) prior to passing through a different part of the test conduit (104) for delivery to the manifold system (58).

7. The method according to any preceding claim including the step of connecting the test flow outlet (76) of each wellhead tree (212) to the manifold system (130) by an individual test conduit (210).

8. The method according to claims 2 and 7 including the step of opening the test flow valve (76) of a selected one of the wellhead trees (212) only while maintaining the others closed and passing output from the selected wellhead tree (212) to the testing means via the corresponding individual test conduit (210).

9. The method according to any preceding claim wherein the manifold system comprises a docking manifold (130) for receiving one or more system modules (132, 158, 180) for

acting on wellhead tree outputs flowing through the manifold system and the method includes docking at least one such system module (132, 158, 180) in the docking manifold (130).

10. The method according to claim 9 wherein at least one said system module (132) docked in the docking manifold (130) simply provides through connection firstly (150) between the production flow outlets (72) of the wellhead trees (50...) and a production pipeline (60) connecting the docking manifold (130) and the host facility (64) and secondly (152) between the test flow outlets (76) of the wellhead trees (50...) and a test pipeline (62) connecting the docking manifold (130) and the testing means which is situated at the host facility (64), the method including the step of conveying output from a selected one of the wellhead trees (50...) to the testing means via the system module (132).

11. The method according to claim 9 wherein at least one said system module (158) docked in the docking manifold (130) firstly (164, 160) provides simple throughflow connection between the production flow outlets (72) of the wellhead trees (50...) and a production pipeline (60) connecting the docking manifold (130) and the host facility (64) and secondly (168, 160) includes the testing means (162), the method including the step of conveying output from a selected one of the wellhead trees (50...) to the testing means (162) of the system module (158) and analysing its contents.

12. The method according to claim 9 wherein at least one said system module (180) docked in the docking manifold

(130) includes the testing means (202) and separating means (194) for separating constituent components of the flows from the wellhead trees (50...), the method including the step of operating the valve means (74, 78) of the wellhead trees (50...) to divert the output from one selected wellhead tree test flow outlet (76) only to the separating means (194) and measuring and/or analysing its contents with the testing means (202).

13. The method according to any preceding claim wherein control signals for controlling the valve means (74, 78) of each wellhead tree (50...) are provided from the host facility (64).

14. The method according to claim 13 wherein the control signals are routed to the wellhead trees (50...) via the manifold system (58) but without passing through any control means forming part of the manifold system (58).

15. The method according to claim 13 wherein the control signals are routed to the wellhead trees (50...) without passing through the manifold system.

16. The method according to claim 9 wherein at least one of the system modules (158, 180) includes the testing means (162, 202), the method including the step of conveying output from a selected one of the wellhead trees (50...) to the testing means (162, 194) of the system module (158, 202).

17. A method of operating a hydrocarbon extraction system including the methods of claims 10 and 12 including the steps of employing the method of claim 10 involving

conveying output from a selected one of the wellhead trees (50...) to the testing means via the system module (132) and the test pipeline (62) and subsequently employing the method of claim 12 and conveying one of the constitute components from the separating means (194) to the host facility (64) via the pipeline (190) previously used as the test pipeline (62).

18. Apparatus for controlling flows from plural hydrocarbon extraction wellhead trees (50...) in an extraction system including plural wellhead trees (50...) connected by a pipeline network (60, 62, 88, 104) to a host facility (64) via a manifold (58) situated remotely from the host facility (64) characterised by each wellhead tree (50...) having a production flow outlet (72), a test flow outlet (76) and valve means (74, 78) operable to selectively divert output from the wellhead tree (50...) through one of the outlets (72, 76) and the interconnecting pipeline network for delivering the output from one of the test flow outlets (76) to the testing means.

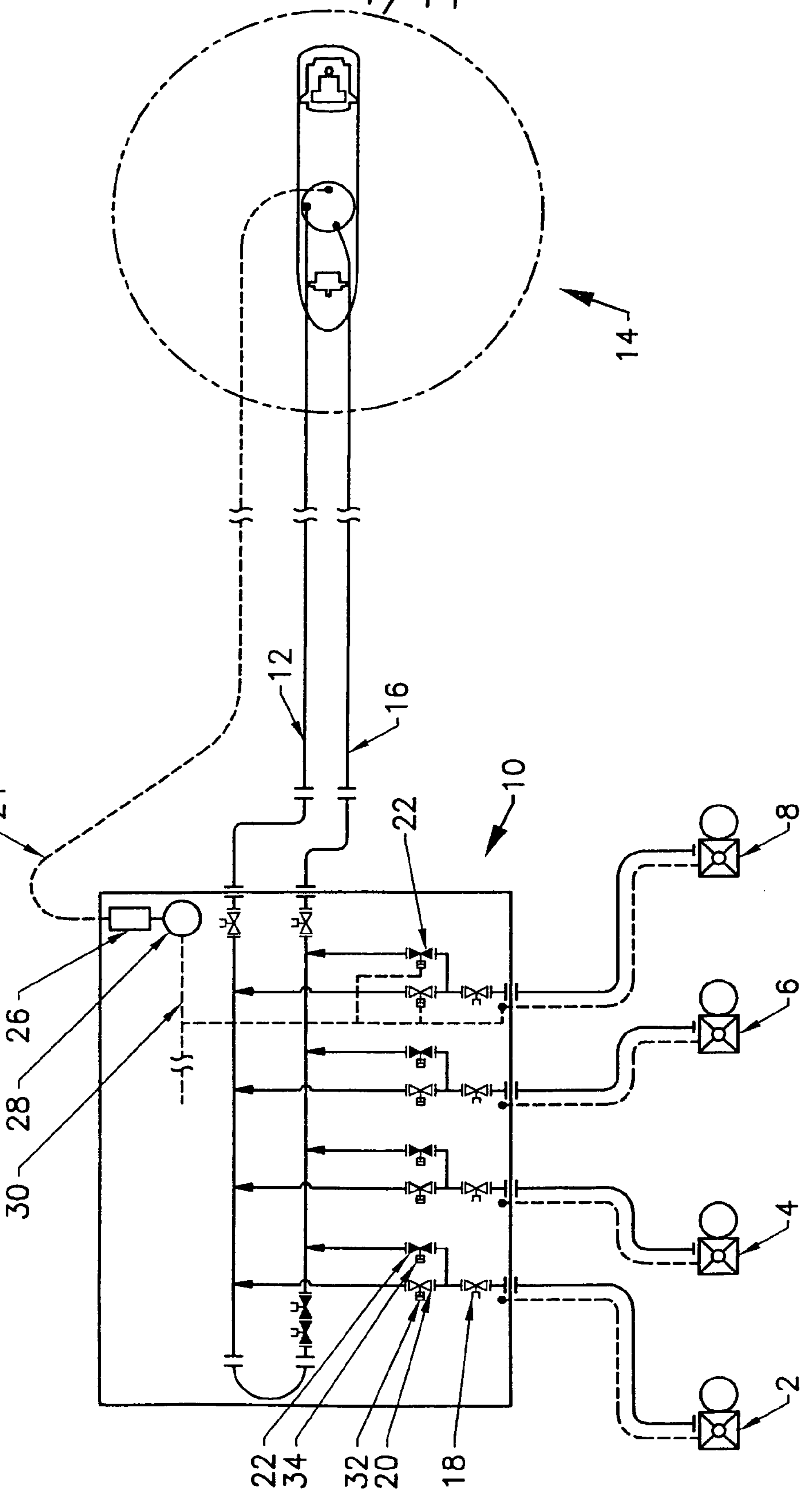

Fig. 1

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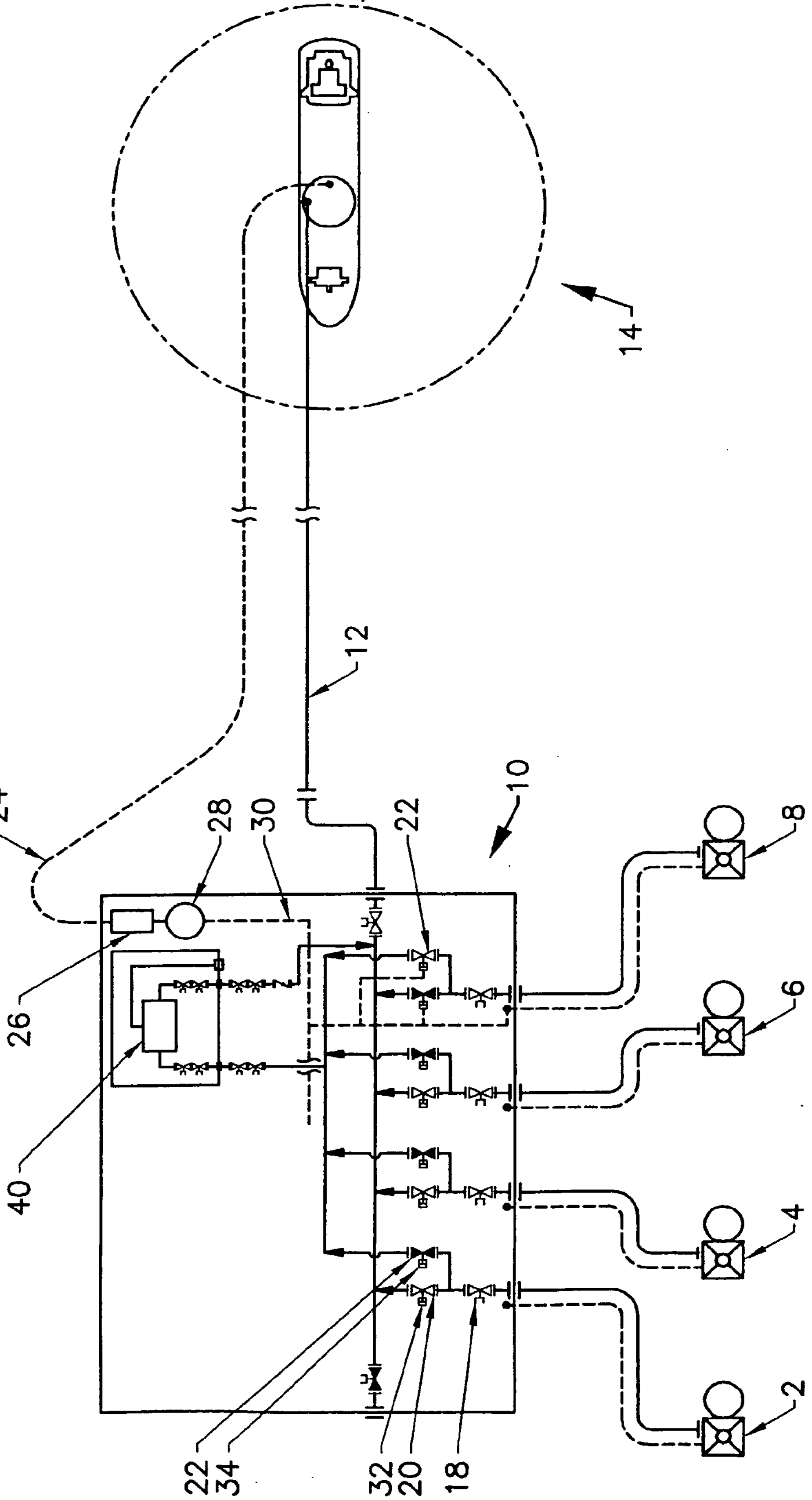

Fig. 2

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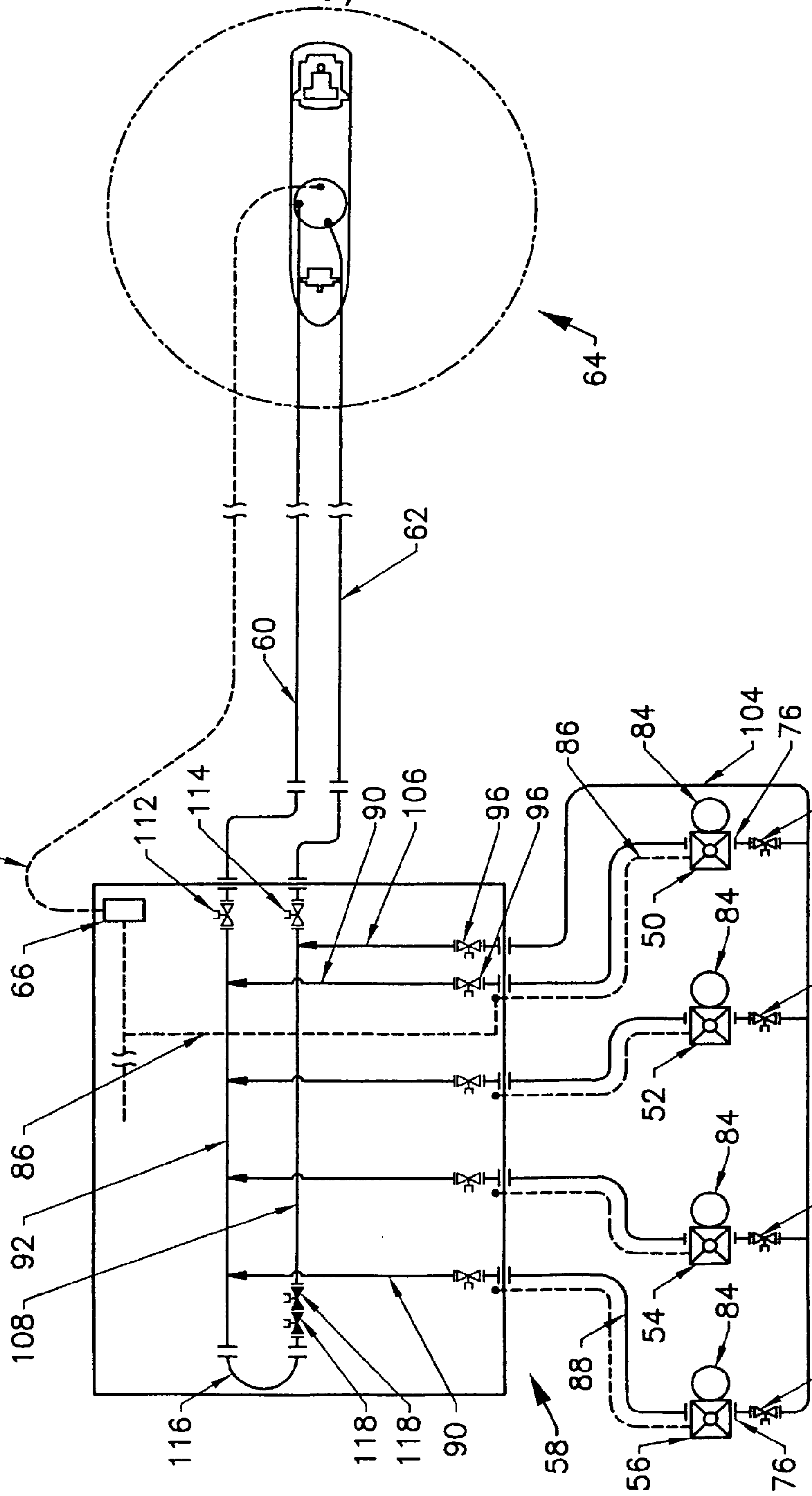

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Fig. 3

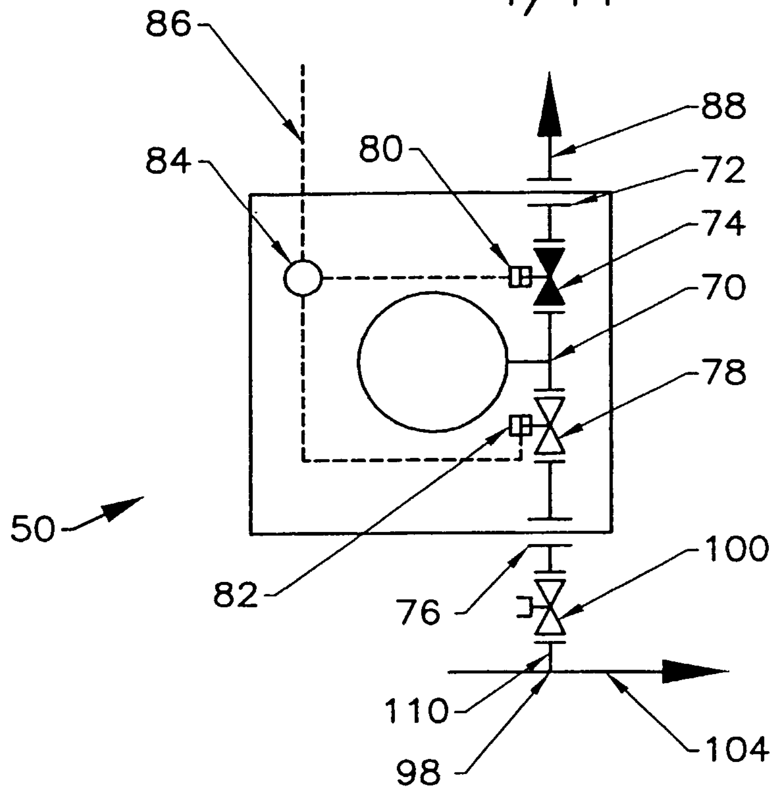
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Fig. 4

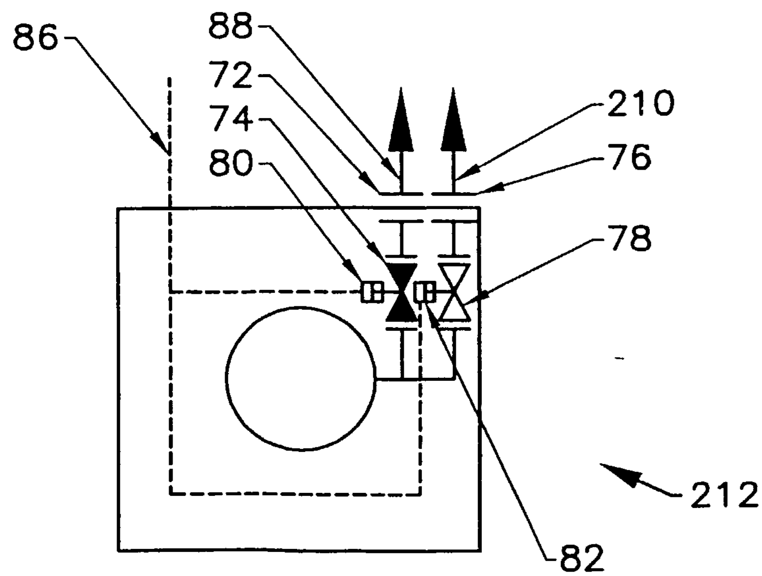
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Fig. 12

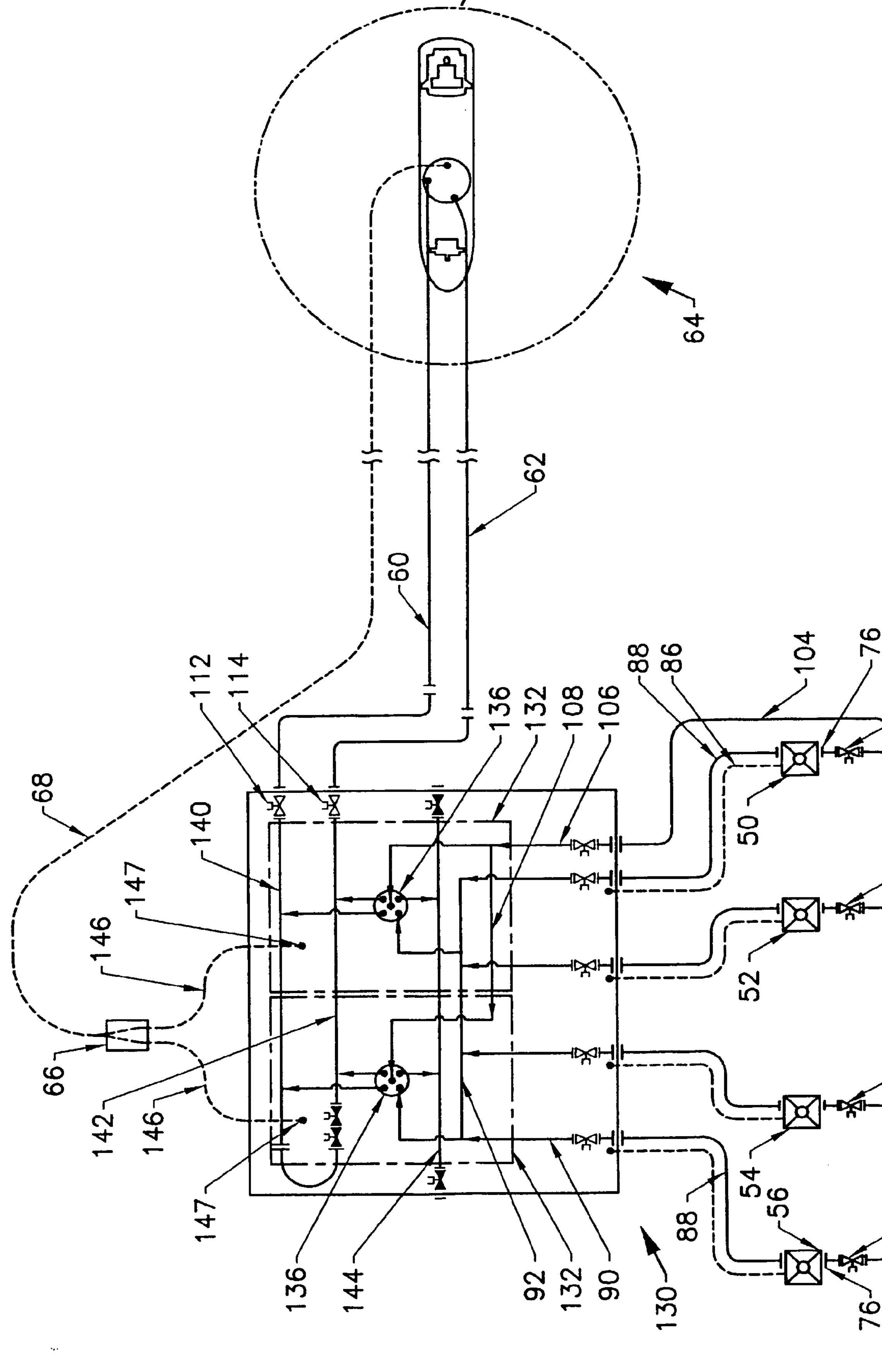
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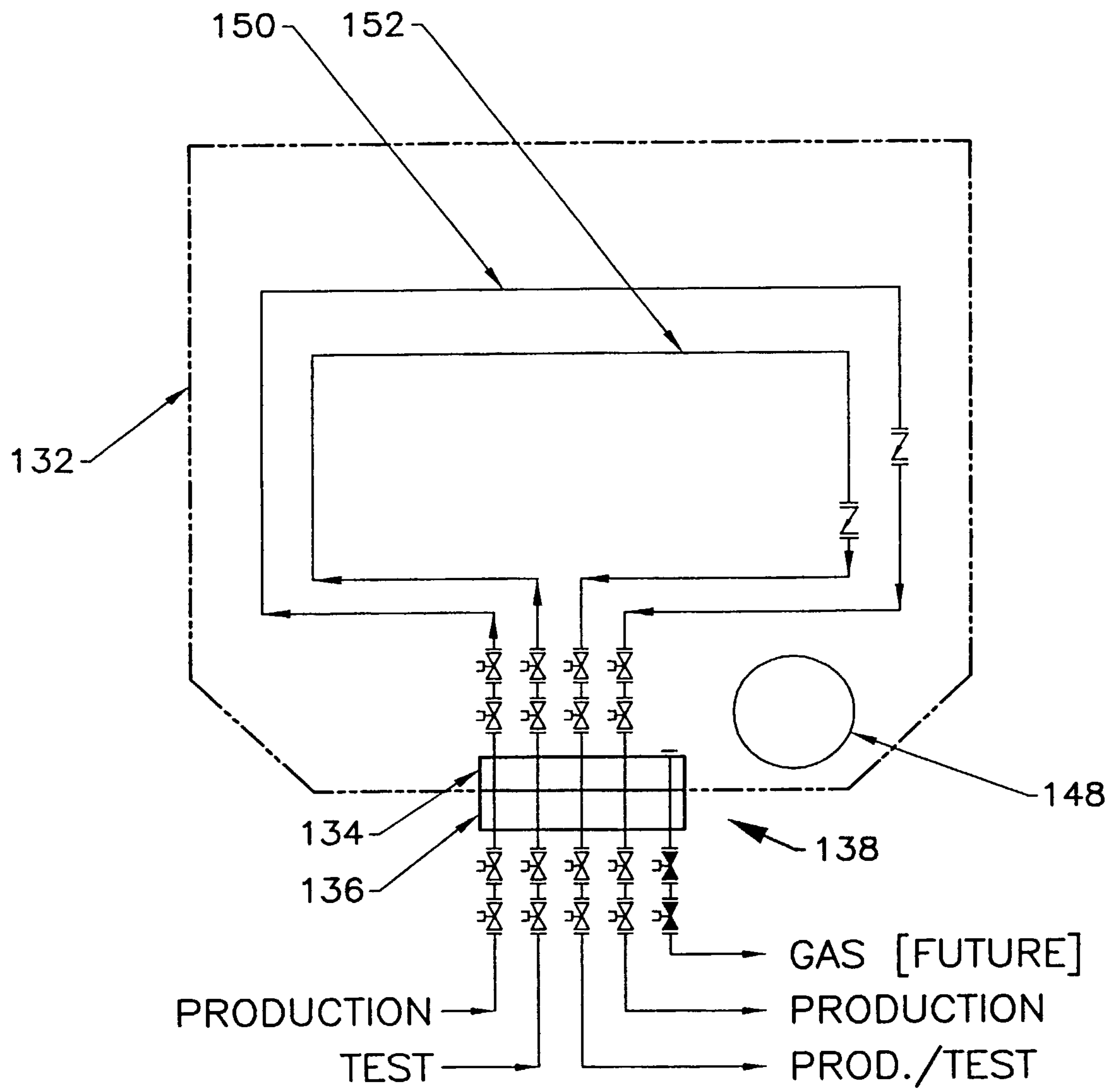
Fig. 5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GAS [FUTURE]
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PRODUCTION
TEST
PROD./TEST

Fig. 6

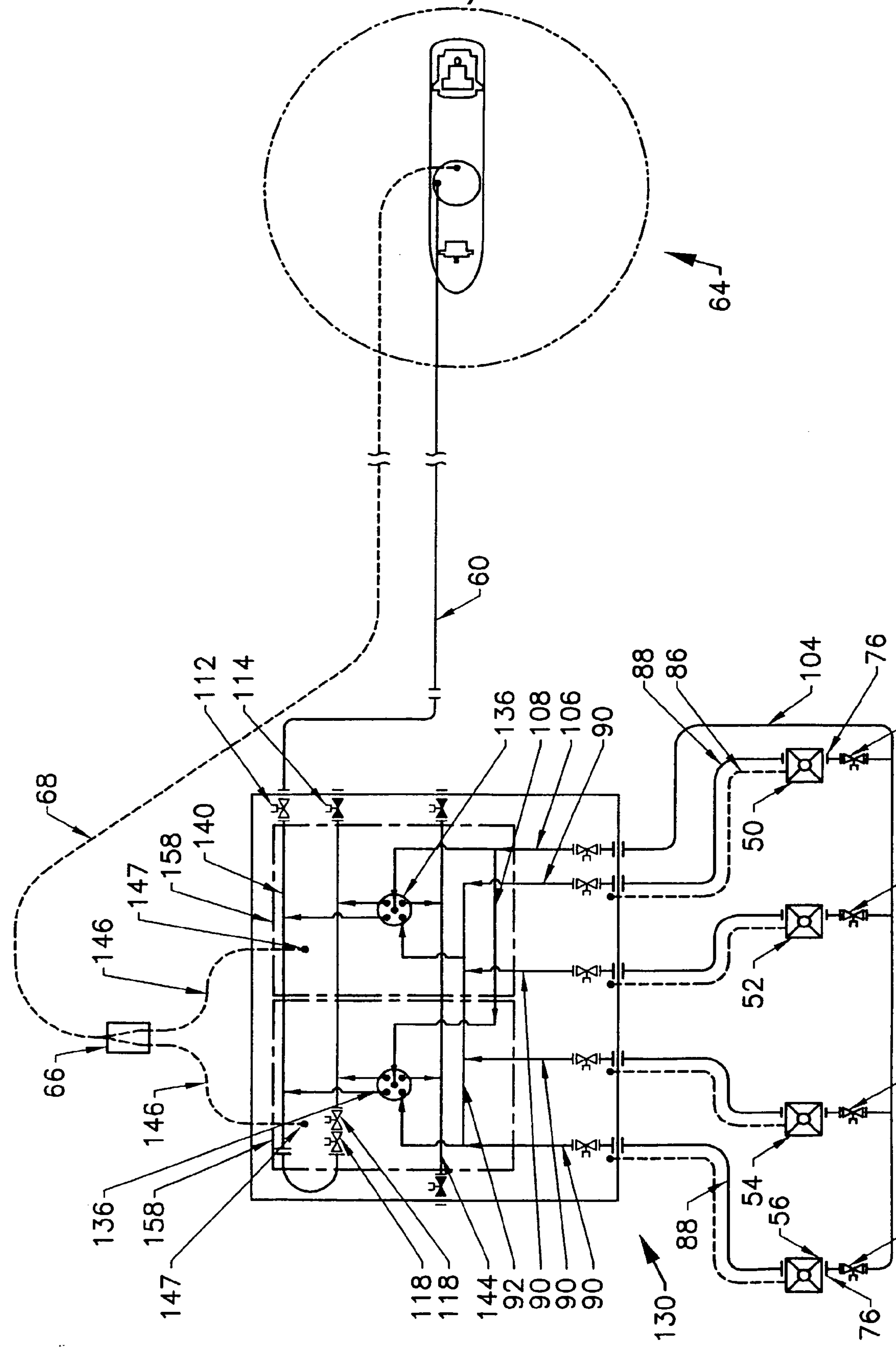

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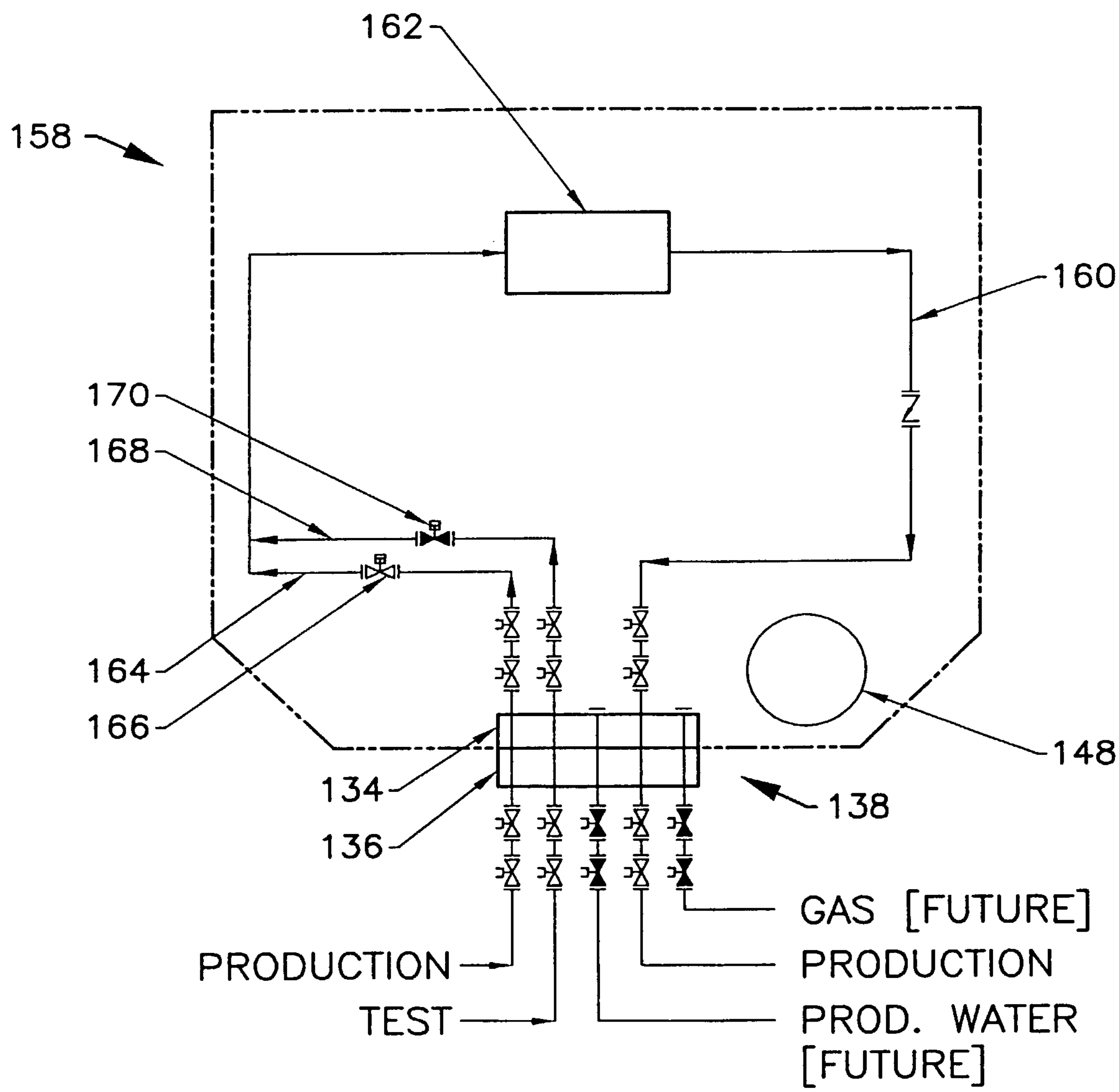
Fig. 7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PRODUCTION
TEST
PROD. WATER
[FUTURE]

Fig. 8

9/11

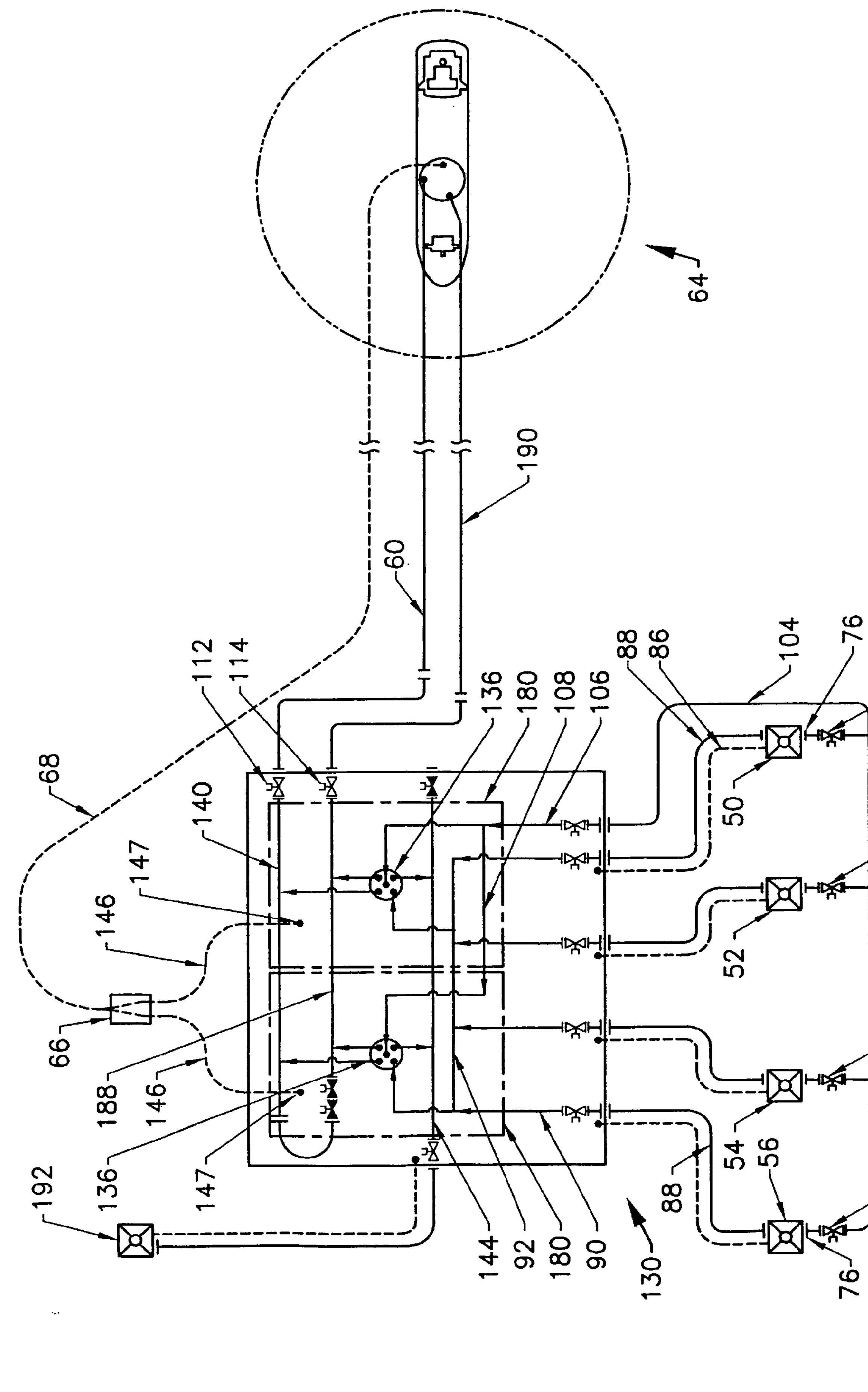
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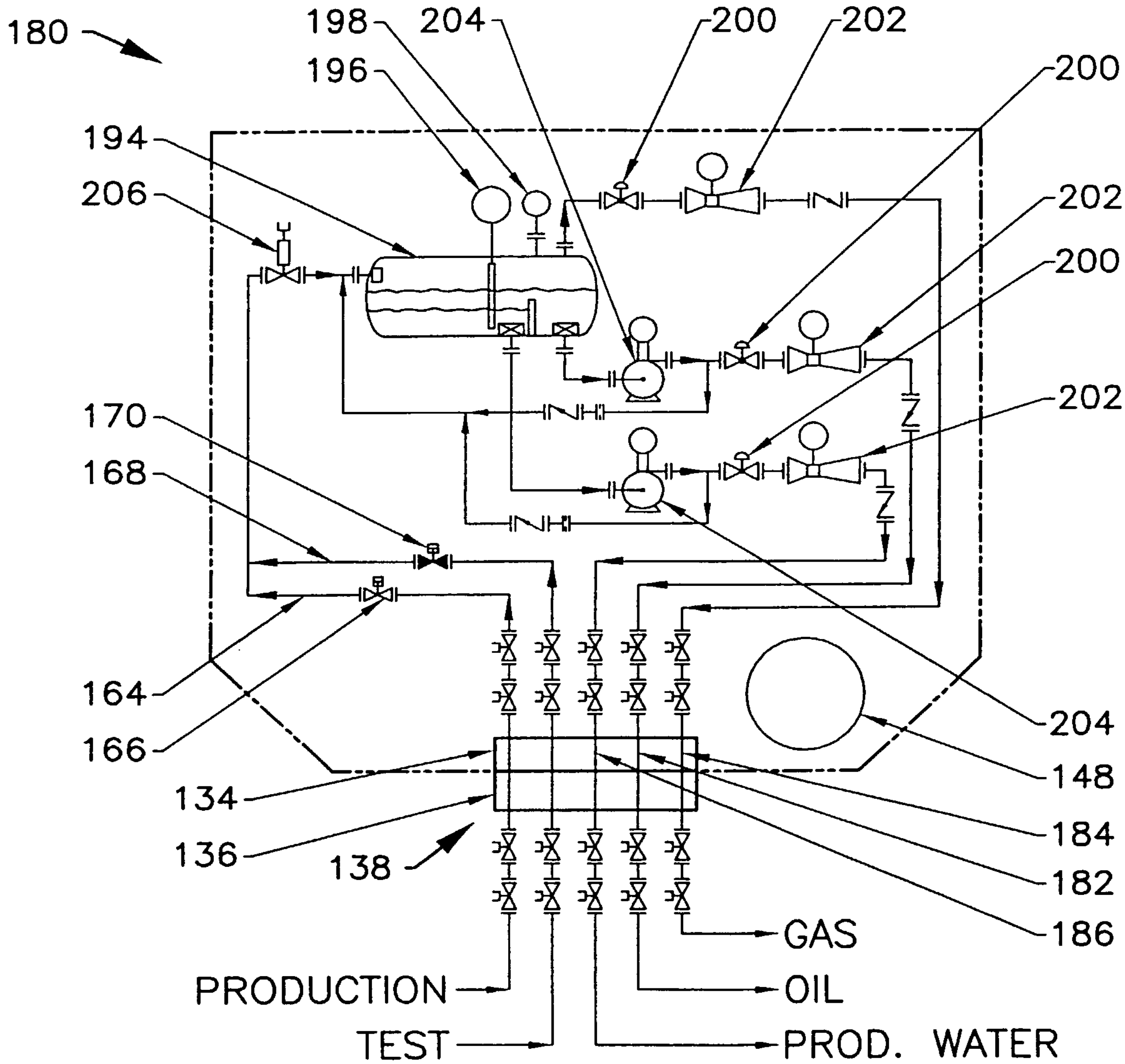
Fig. 9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PRODUCTION
OIL
TEST
PROD. WATER

Fig. 10

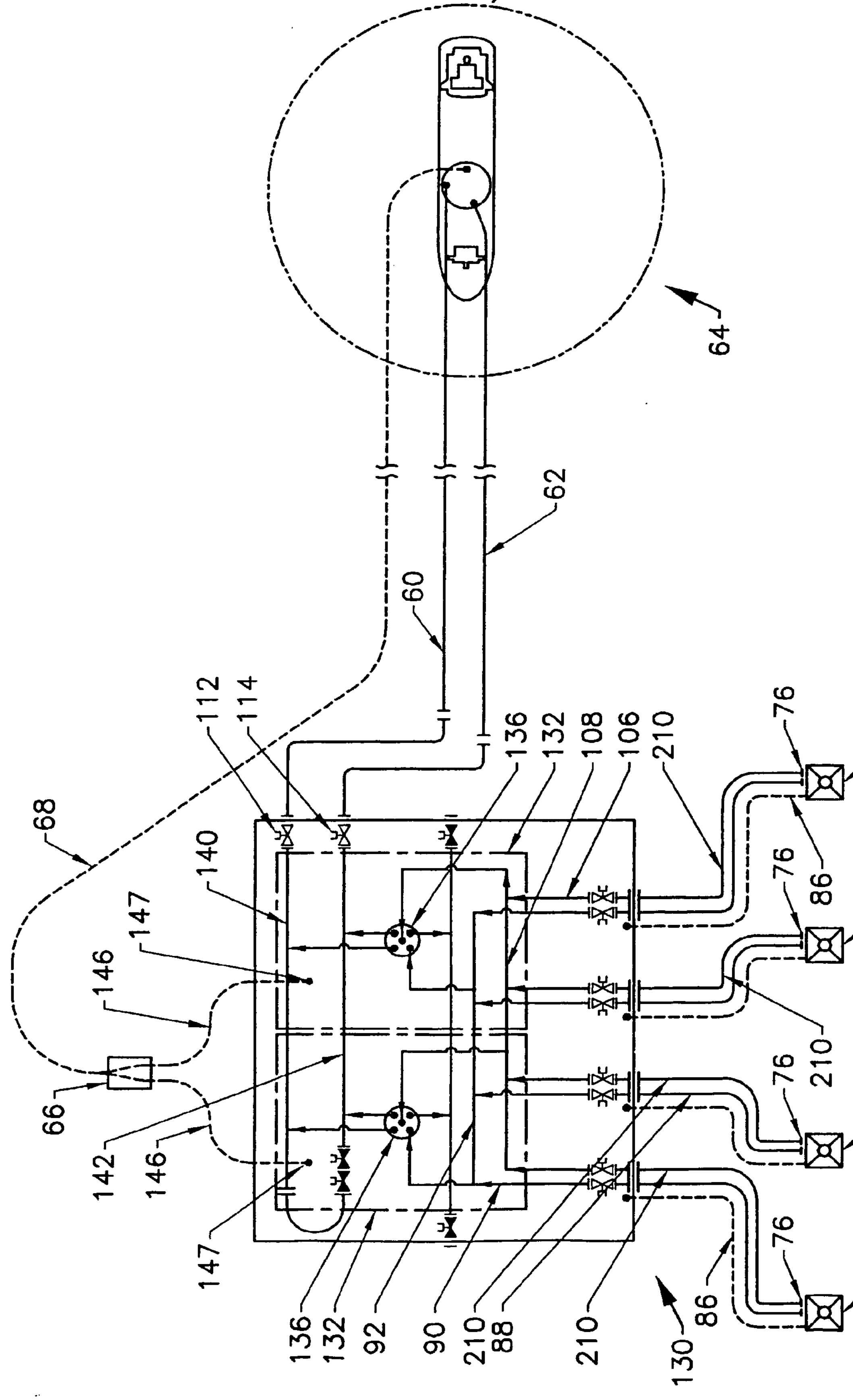

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Fig. 11

INTERNATIONAL SEARCH REPORT

I tional Application No
PCT/GB 02/01924

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B43/017 E21B43/36 E21B34/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, TULSA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01 12948 A (COFLEXIP ;COFLEXIP STENA OFFSHORE LTD (GB); WHITE ROBERT (GB); CRI) 22 February 2001 (2001-02-22) page 2, line 1 - line 7	1-18
A	GB 2 028 400 A (OTIS ENG CORP) 5 March 1980 (1980-03-05) figure 2	1-18
A	US 4 848 474 A (PARIZOT CLAUDE ET AL) 18 July 1989 (1989-07-18) column 2, line 43 - line 51	1-18
A	GB 2 281 925 A (CONSAFE ENG UK LTD) 22 March 1995 (1995-03-22) page 7, line 28 - line 38	1-18

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 September 2002	09/09/2002

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 02/01924

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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